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Threat Status of Some Protected Bryophytes in Hungary

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Abstract. In this paper estimation of threat status in Hungary is given for five bryophyte species (*Buxbaumia viridis, Dicranum viride, Frullania inflata, Lophozia ascendens, Pyramidula tetragona*). All of these species should be placed into the critically endangered (CR) new IUCN category. In most cases decline can be detected. The number of the localities of three species has decreased. The area of occupancy is usually very restricted. But the most severe threat is the very small size of the populations, subpopulations. This latter criterion has crucial importance in the estimation of threat status of these species in Hungary.

Keywords: threat status, bryophytes, Hungary

Introduction

Recently 80 bryophyte species are legally protected in Hungary. Most of them (50 species) are included in the Red Data Book of European Bryophytes (RDB) (ECCB 1995), and the others are locally rare species living in endangered mires and wet meadows. The Hungarian legally protected bryophyte species are enumerated in the Appendix of PAPP et al. (2002). Intensive bryological investigations are going on concerning the distribution of these rare species, changes of their populations and estimate their threat status according to new IUCN categories (IUCN 1994). Guidelines for application of new IUCN threat categories to bryophytes were given by HALLINGBÄCK et al. (1998).

This paper deals with five bryophyte species (*Buxbaumia viridis, Dicranum viride, Frullania inflata, Lophozia ascendens, Pyramidula tetragona*), whose investigation almost has finished in Hungary and our knowledge

about them is enough to the estimation of their threat status. Similar paper was published by HALLINGBÄCK (1998) about the evaluation of threat categories for rare Swedish bryophytes. A case study for estimating population size and threat status of *Fissidens arnoldii* in Hungary was given in Papp et al. (2000).

Methods

To obtain the earlier distribution data of the investigated species the Bryophyte Herbarium of the Hungarian Natural History Museum, Budapest (BP) and Eger Teacher's College (EGR) were consulted. The retrieval was mainly based on locality description of herbarium specimens and the diaries of Ádám Boros and László Vajda about their field trips (Boros 1915–1971, Vajda 1933–1978) as well as published records (BOROS 1968, ORBÁN and VAJDA 1983).

The earlier found localities were visited (in the case of unsuccessful confirmations two or three times). If the bryophyte was found on the locality, the size of its population was estimated and its potential habitats in other localities were also investigated. In the case of unsuccessful confirmation habitat conditions of the site were investigated in order to see if we may expect finding it again, or if the site has changed so dramatically (or even had been destroyed) that we can not regard the site as the potential habitat of the species any more.

To estimate the threat status according to the new IUCN categories (IUCN 1994) the following criteria should be taken into consideration (HALLINGBÄCK et al. 1998):

Criteria

(A) Large decline

Major population decline observed, estimated, inferred or suspected in the last 10 years or 3 generations, whichever is the longer, based on:

80% or more = CR (Critically Endangered)

50% or more = EN (Endangered)

20% or more = VU (Vulnerable)

(B) Restricted area of occupancy, few localities

Recently recorded within only one 10 km × 10 km square and found in only one locality or the populations are severely fragmented. It means small subpopulations that are all more or less isolated = CR.

Recently recorded in five or fewer 10 km × 10 km squares and found in two to five localities or the populations are severely fragmented = EN.

Recently recorded in ten or fewer 10 km × 10 km squares and found in ten or fewer localities or the populations are severely fragmented = VU.

(C) Small population and decline
Small population:
fewer than 250 mature individuals = CR
fewer than 2,500 mature individuals = EN
fewer than 10,000 mature individuals = VU
together with either
(C1) Large decline:
at least 25% in 3 y. or 1 generation = CR
at least 20% in 5 y. or 2 generations = EN
at least 10% in 10 y. or 3 generations = VU
or
(C2) Continuing decline and restricted only a single population or continuing decline and small subpopulations:
no subpopulation estimated to contain more than 50 mature individuals = CR
no subpopulation estimated to contain more than 250 mature individuals = EN
no subpopulation estimated to contain more than 1000 mature individuals = VU

(D) Very small or restricted populations
Fewer than 50 mature individuals = CR
Fewer than 250 mature individuals = EN
Fewer than 1000 mature individuals (sub-criterion D1) or an area of occupancy less than five 5 km × 5 km squares or 4 or fewer localities (sub-criterion D2) = VU

In the course of the evaluation of the threat status, the species should be categorized as far as possible according to all criteria and at last the highest IUCN category has to be taken into consideration.

Results

Buxbaumia viridis (Moug. ex Lam. et DC.) Brid. ex Moug. et Nestl. is a boreal, montane moss. In Hungary, it has only one record from decaying wood, (which is its main substrate in Western and North Europe, (ECCB 1995)) and in the other localities it was found on acidic soils in humid forests (Papp et al. 2002). It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats

and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). It has 7 earlier records from Hungary (PAPP et al. 2000). The identification of the species is proved to be not easy (PAPP et al. 2002). As a result of the revision of the specimens deposited in the Herbarium of the Hungarian Natural History Museum (BP) two earlier localities can be excluded and other two are doubtful data (see below).

Old occurrence confirmed: Borsod-Abaúj-Zemplén County, Bükk Mts. Nagyvisnyó, in valley Leány-völgy at Hollókő rocks, on decaying beech log, 720 m a.s.l., 01.10.1999, leg. and det. Ódor, P., Papp, B., Szurdoki, E. Earlier data from here: 07.08.1953, leg. and det. Boros, Á. The size of the population was very small. In total 14 sporophytes were counted in 1999 on three logs in a very advanced stage of decay. In 2000 only one tree was already colonized by the species. In 2001 and 2002 the species was not found. For the estimation of population size the colonized trees can be counted as individuals because the destruction of the substrate will affect all plants growing on it. The biggest population size detected in last years is 3.

Former locations checked without success: Borsod-Abaúj-Zemplén County, Zemplén Mts, Nagy-Hemzső hill at Telkibánya, 19.06.1960. leg. and det. Vajda, L. It was collected from soil in a *Quercetum.*

Veszprém County, Viszló forest at Tapolca, 02.05.1959. leg. and det. Vajda, L. It was found on soil in a *Quercetum.*

Earlier specimens with juvenile sporophytes, the data are doubtful, localities are recently checked without success: Nógrád County, Börzsöny Mts, Bacsina-valley at Királyháza, under the hill Rakottyás-bérc, from soil, 08.05.1959. leg. and det. Vajda, L.

Budapest, Buda Mts, Hárs hill at Hűvösvölgy (Budapest), from soil along the footpath, 10.02.1957. leg. and det. Vajda, L.

Excluded earlier localities, specimens turned out to be Buxbaumia aphylla: Baranya County, Mecsek Mts, Éger-valley at Magyarürög (Pécs), 27.06.1952. leg. and det. Vajda, L.

Heves County, Mátra Mts, Hársas-tető hill above the stream valley of Köszörű-patak at Parád, 01.10.1956. leg. and det. Boros, Á.

(A) The presence of the species was confirmed only in one locality in Hungary. According to the old specimens it has 5 earlier localities. The decline is about 80%.

(B) It has been recorded recently from one 10 km × 10 km square.

(C) and (D) The population size is smaller than 50 individuals.

Conclusion: It corresponds to the critically endangered (CR) category according to all Criteria (A, B, C, D) of IUCN.

Dicranum viride (Sull. et Lesq.) Lindb. is a subcontinental, montane moss. It occurs on tree trunks in humid forests, mainly on the lower part of the trees. It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). Some of the new occurrences in Hungary had been published earlier (ERZBERGER 1999).

New occurrences: Borsod-Abaúj-Zemplén County, Bükk Mts, Őserdő (Old Forest), Répáshuta, on *Fagus* trees, ca 860 m a.s.l., 12.08.2001. leg. and det. Papp, B., Erzberger, P.

In this forest the close relative of *Dicranum viride*, *D. tauricum* also lives. It is difficult to distinguish them in the field (PAPP et al. 2002). *Dicranum viride* like patches were detected on 37 *Fagus* trees. On the basis of the identification of the samples *Dicranum viride* were found on 26 trees, while *D. tauricum* was collected from 11 trees. 2 trees were colonized by both species. The population size is equivalent to the number of trees colonized as destruction of the phorophyte will affect all plants growing on it. Therefore, counting the individual bryophyte plants or cushions on each tree would lead to an over-estimation of population size and to an under-estimation of threat. Hence the population size of *Dicranum viride* is 26.

Borsod-Abaúj-Zemplén County, Bükk Mts, Ódor-vár hill in Hór-valley, Cserépfalu, *Quercetum* on the southern slope, on *Quercus cerris*, ca 350 m a.s.l., 06.08.1998. leg. de Bruyn, U., Erzberger, P. det. Erzberger, P. The species was collected from one tree.

Heves County, Bükk Mts, Várhegy hill, Felsőtárkány, *Quercetum*, on siliceous rock, ca 600 m a.s.l., 08.08.1998. leg. Siemsen, M., Erzberger, P., det. Erzberger, P. The species was found on one rock.

Borsod-Abaúj-Zemplén County, Bükk Mts, Szárba-oldal hill in Hór-valley, Cserépfalu, *Quercetum*, on *Quercus* tree, ca 450 m a.s.l., 09.08.1998. leg. Klawitter, J., Erzberger, P., det. Erzberger, P. and 06.11.2001. leg. and det. Papp, B. The species was found on several trees. But the population size certainly does not reach 50.

Old occurences confirmed: Borsod-Abaúj-Zemplén County, Bükk Mts, Füzérkő in Hór-valley, Cserépfalu, on the southern and eastern slope of the hill, on deciduous trees and on decaying wood, (N 47°59, 993′, E 20°31, 226′), ca 340 m a.s.l., 28.09.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 30.03.1959. leg. and det. Boros, Á. The species was detected on 9 *Quercus*, 4 *Carpinus*, 2 *Fagus*, 1 *Tilia*, 1 *Crataegus* trees and 2 decaying wood. The size of this population is 19.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vadásztető hill, Pálháza, on *Fagus* tree, ca 450 m a.s.l., 19.06.2000. leg. and det. Papp, B. Earlier data: 01.08.1953. leg. and det. Vajda, L. The species was collected from one tree.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vajda-valley, Pálháza, on andesite rock, ca 300 m a.s.l., 19.06.2000. leg. and det. Papp, B. Earlier data: 06.10.1953. leg. and det. Boros, Á., Vajda, L. One small patch of the species was found on an andesite rock. Around the beech forest was cut down. There is no suitable substrate for the species. This population is very endangered, almost died out.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Piszkéstető hill, Hollóháza, on *Fagus* tree, (N 48°31, 222′, E 21°25, 058′) ca 500 m a.s.l., 27.09.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 30.02.1954. leg. and det. Vajda, L. The species was collected from one tree.

Szabolcs-Szatmár-Bereg County, Nyírség region, Bátorliget, *Betula* trees in meadow, ca 120 m a.s.l., 08.09.2000. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 04.11.1989. leg. Barabás, K., Tóth, Z. det. Tóth, Z., Orbán, S. and 30.06.1996. leg. and det. Jakab, G. Several trees are colonized by *Dicranum viride* like species. *D. tauricum* also occurs on the territory, hence the estimation of population size is difficult. But the population size certainly does not reach 50.

Zala County, Göcsej region, in the Vétyem Forest Reserve, Tormafölde, on decaying wood, ca 200 m a.s.l., 24.06.2001. leg. Papp, B., Szurdoki, E., det. Papp, B. Earlier data: 12.07.1955. leg. and det. Boros, Á. One decaying beech tree of large size was colonized by the species near a small stream. The species cover 60 cm^2 on the tree. The population size 1.

Former locations checked without success: Borsod-Abaúj-Zemplén County, Aggteleki-karszt Mts, Vecsembükki-zsomboly, Bódvaszilas, 02.11.1937. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Szent István kilátó hill, Lillafüred, 25.06.1932. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Savós-valley, Hámor, 03.08.1922. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, at Létrás cave, Jávorkút, 19.09.1968. leg. and det. Boros, Á.

Borsod-Abaúj-Zemplén County, Bükk Mts, Magoskő hill, Ómassa, 16.05.1951. leg. and det. Boros, Á.

Borsod, Abaúj-Zemplén County, Bükk Mts, Tarkő hill, Szilvásvárad, 06.10.1951. leg. and det. Boros, Á., Vajda, L.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Szárazkút valley at Kő-

kapu rocks, Pálháza, 25.05.1947. leg. and det. Vajda, L., 29.06.1969. leg. and det. Boros, Á.

Veszprém County, Bakony Mts, Sombereki-séd valley, Ugod, 17.05.1954. leg. and det. Boros, Á., Vajda, L.

Usually the forests have changed on these localities, became drier, the stands are influenced by intensive forestry activity, contain individuals in the same age and only a few old trees have remained, the forest parts are fragmented by clearcut and young regeneration of trees.

(A) The species was confirmed in 6 earlier locality, it has 4 new records and on 8 earlier localities the search was unsuccesful. The decline is about 30% if take into consideration the 14 earlier and the recently known 10 localities, but it supposed that the decline occurred more than 10 years ago. It corresponds to the VU category.

(B) The recently existing 10 populations can be found in 7 10 km × 10 km squares. It corresponds to the VU category.

(C) The population size does not exceed 250 mature individuals. The subpopulations are usually very small, not more than 50 mature individuals. It corresponds to the CR category.

(D) The number of individuals does not exceed 50 in any locality. This also corresponds to the CR category.

Conclusion: Since always the highest IUCN category has to be taken into consideration we can conclude that *Dicranum viride* is a critically endangered (CR) species in Hungary.

Frullania inflata Gottsche var. *inflata* is a thermophilic, submediterranean, montane liverwort. It lives on siliceous rocks (granite, basalt, gneiss). The species is very rare throughout its range in Europe. It is known from 6 European countries only (SÖDERSTRÖM et al. 2002). It is vulnerable in Europe according to the Red Data Book of European Bryophytes (ECCB 1995).

Old occurrence confirmed: Zala County, Balaton-felvidék region, Mt Tátika, Zalaszántó, Tinóállás rocks at the southern slope of the hill, on shaded basalt rocks, ca 350 m a.s.l., 30.03.2002. leg. and det. Papp, B., Erzberger, P. Earlier data from here: 03.06.1955, leg. and det. Vajda, L., 30.04.1956, leg. and det. Boros, Á., Vajda, L. Three patches of 3 cm^2 × 3 cm^2 were found on two rocks. For the estimation of population size the small patches can be treated as individuals, hence the population size is 3.

New occurrence: Heves County, Bükk Mts, Szarvaskő, 10 km NNW of Eger, Vár-hegy, southern slope of the hill, on partly shaded volcanic bedrock (diabas), (UTM DU 51), ca. 250 m a.s.l., 23.04.1998. leg. Pócs, T.

and Erzberger, P., det. Pócs, T. Several (not more than 10) small patches (a few cm^2 each) were found. The population size is not more than 10.

(A) Decline is not detectable.

(B) It has been recorded recently from two 10 km × 10 km squares. It corresponds to the EN category.

(C) and (D) The population size is smaller than 50 individuals and the populations are severely fragmented as the two localities are very far from each other. It corresponds to the CR category.

Conclusion: Frullania inflata is considered as critically endangered (CR) species in Hungary.

Lophozia ascendens (Warnst.) Schust. is a boreal, montane liverwort, it lives on well-decayed logs (obligate epixylic species). It is a rare species according to the Red Data Book of European Bryophytes (ECCB 1995).

New occurrences: Heves County, Mátra Mts, Mátraháza, N slope of the Kékes hill in the Kékes North Forest Reserve, on decaying logs, ca 900 m a.s.l., 20.06.1999, leg. and det. Ódor, P. It occurs on 4 well-decayed logs, the size of the patch inhabited by the population is ca 1 m^2. As in the case of *Buxbaumia viridis* the colonized trees can be counted as individuals. The population size is 4.

Heves County, Bükk Mts, Nagyvisnyó, in valley Leány-völgy at Hollókő rocks, on decaying beech log, 720 m a.s.l., 17.11.1999, leg. Ódor P., Papp B. det. Ódor P. (Papp et al. 2000). It occurs in a well-decayed log, the size of the patch inhabited by the population is ca 100 cm^2. The population size is 1.

Localities checked without success: Borsod-Abaúj-Zemplén County, Bükk Mts, Jávorkút, on decaying log in a planted old spruce forest, 27.08.1959, leg. and det. Vajda, L. The forest was cut, the habitat is completely destroyed.

Borsod-Abaúj-Zemplén County, Zemplén Mts, on decaying log near the stream in valley Határ-völgy at Kőkapu near Pálháza, 24.06.1953, leg. and det. Vajda, L. Around the valley big parts of the forests were cut, the habitat became drier and there are only a few decaying logs.

(A) The species has disappeared from Zemplén Mts, but it was discovered in Mátra Mts. An earlier location has been destroyed in Bükk Mts, but it was found in a new location in the mountain. Decline is not detectable.

(B) It has been recorded recently from two 10 km × 10 km squares. It corresponds to the EN category.

(C) and (D) The population size is very small, only a few individuals and the populations are severely fragmented, located in different mountains. It corresponds to the CR category.

Conclusion: Lophozia ascendens can be regarded as critically endangered (CR category) species in Hungary.

Pyramidula tetragona (Brid.) Brid. is a submediterranean, subatlantic species. It is a short lived moss occurring in open grasslands mainly in spring and autumn. It is included in the Bern Convention (The Convention on Conservation of European Wildlife and Natural Habitats, 1979), and in the European Community Directive on the Conservation of Natural Habitats and Wild Fauna and Flora, 1992. It is vulnerable according to the Red Data Book of European Bryophytes (ECCB 1995). It was known from 8 localities in Hungary (PAPP et al. 2000). Usually it grows in patches of 1–2 cm diameter. Frequently several patches can be found close to each other within a 1 m^2 square. In extended grasslands, as e.g. in Szent György hill, 5–10 m away from such a square, other groups of 2–5 patches can often be found. As the life strategy of this species is annual shuttle (AS), it appears in spring, produces spores very quickly, then it dies in the dry season and in autumn it may appear again. The size of the population could be very variable in different years, because the presence of the species is strongly connected with the weather conditions as e.g. the time and quantity of rains (PAPP et al. 2002). To estimate the population size, patches of 1–2 cm diameter, which are dense turf of shoots probably growing from the same prothallium, can be regarded as individuals.

Old occurrences confirmed: Zala County, Balaton-felvidék, Mt Tátika at Zalaszántó. On soil in open basalt grassland facing NW, ca 300 m a.s.l., 22.04.1999, leg. and det. Papp, B., Ódor, P. Earlier data from here: 03.05.1954. leg. and det. Boros, Á.

Zala County, Balaton-felvidék, Mt Gulács at Nemesgulács. On soil in open, SE facing basalt grassland, ca 360 m a.s.l., 29.04.2000, leg. and det. Erzberger, P., Papp, B., Ódor, P. Earlier data: 02.05.1955, leg. and det. Boros, Á.

New occurrence: Zala County, Balaton-felvidék, Szent György hill, on soil of SE facing open basalt grassland, ca 350 m a.s.l., 13.08.1999. leg. Papp, B., Lőkös, L., Bérces, S. det. Papp, B.

The population sizes in the three localities are summarized in Table 1.

	1999	2000	2001	2002	2003
Mt Tátika	7	4	0	0	0
Szent György hill	8	29	35	13	9
Mt Gulács		10	1	0	0

Table 1. Population size of *Pyramidula tetragona* in the recently known localities in different years. Individuals are equivalent with patches of ca 1 cm^2; dense turf of shoots probably growing from the same prothallium.

Former locations checked without success: Budapest county, Buda Mts, Vihar-hill, Budapest, 24.02.1921. leg. and det. Győrffy, I. Limestone open grassland.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Vajda-valley at Pálháza, 06.10.1953. leg. and det. Boros, Á. On the edge of the forest in a ditch.

Borsod-Abaúj-Zemplén County, Zemplén Mts, Nagy-Milic hill at Füzér, 03.10.1953. leg. and det. Boros, Á., Vajda, L. On the edge of the forest on a stubble field.

Heves County, Mátra Mts, Remete-bérc hill at Mátraháza, 31.10.1931. and 27.04.1961. leg. and det. Boros, Á.

Completely destroyed habitats: Borsod-Abaúj-Zemplén County, Zemplén Mts, Kopasz-hill at Tállya, 27.05.1952. leg. and det. Vajda, L. On open grassland.

Komárom-Esztergom County, Gerecse Mts, Sárási-kő hill at Bajna, 04.04.1949. leg. and det. Boros, Á. On open limestone grassland.

Due to mining activity almost all of the hill slopes with open grasslands are lacking.

(A) The species has two old confirmed and one new localities from some basalt hills close to each other in the same region of Hungary. In 6 earlier known localities the search was unsuccessful. The decline is about 60%, probably occurred more than 10 years ago. But it corresponds to the EN category.

(B) The species has three localities in two 10 km × 10 km squares, which also corresponds to the EN category.

(C) The population size is not more than 250 mature individuals and there is no subpopulation, which contains more than 50 individuals.

(D) The populations are very small, does not exceed 50 mature individuals even in the case of the biggest population (Szent György hill) in the most favourable years (2000, 2001). The threat status of the species is CR category on the basis of the two latter criteria.

Conclusion: Pyramidula tetragona should be placed to the CR category in Hungary.

Conclusions

All the five investigated species should be placed into the critically endangered (CR) new IUCN category. In most cases decline can be detected. The number of the localities of three species has decreased. The area of occupancy is usually very restricted. But the most severe threat is the very small size of the populations, subpopulations. This latter criterion has

crucial importance in the estimation of threat status of these species in Hungary.

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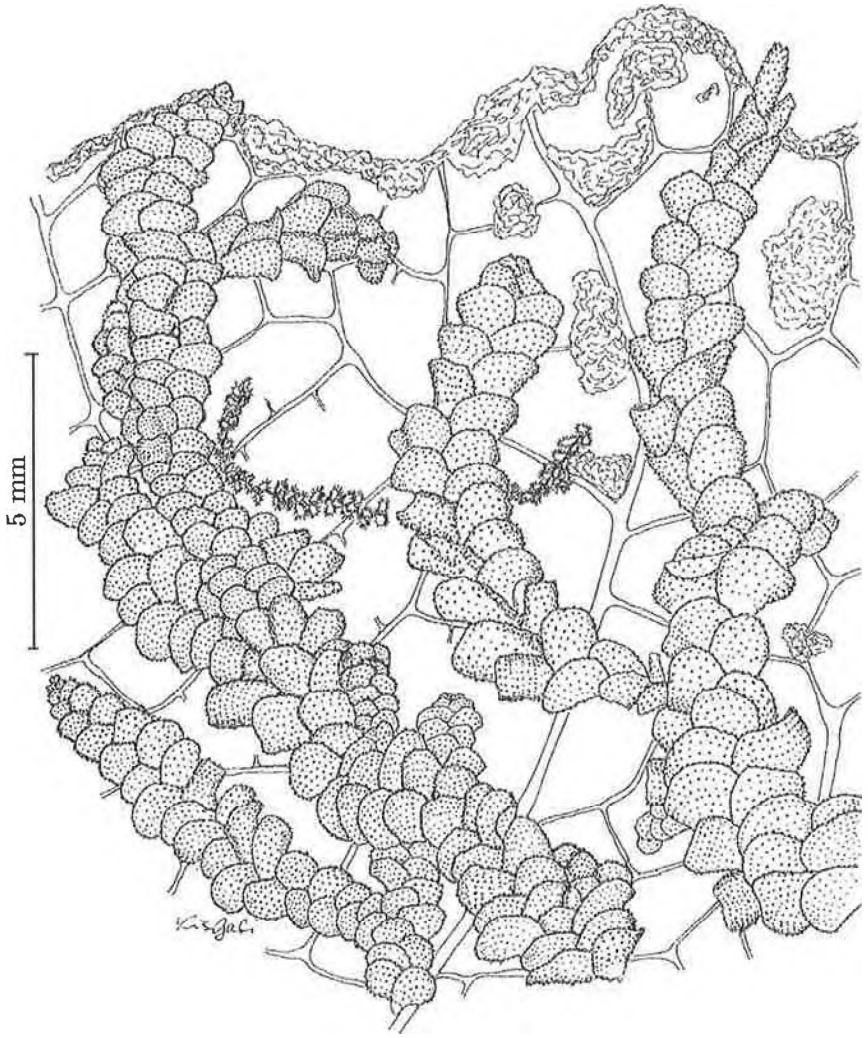

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Papillolejeunea balázsii **Pócs**, 1997. Tropical Bryology 13: 3.
HOLOTYPE: Papua New Guinea
Coll.: D. Balázs NG-14AA (EGR)